1996-08

Graduate Education in Computer Security presentation to Rear Admiral Richard A. Wilson for Computer Science Department Curriculum Review

COMPUTER SECURITY EDUCATION PROGRAM BASED ON A STRONG FOUNDATION

RADM Wilson

- **Teaching**
- **Research**
- **Integration of Computer Security into Computer Science Curriculum**
- **Coherent Matrix of Courses**
- **Program Designed to Serve DoN/DoD needs**

MORE CURRENT AND FUTURE DIRECTIONS FOR INFOSEC STUDIES AND RESEARCH

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- **Binding of Authentication to Access Control in Network Environments**
- **Security Policy Analysis**
- **Computer Intrusion and Misuse Detection**
- **Presentation and Display of Multilevel Database Information**
- **Tools for Secure Network Management**

CURRENT AND FUTURE DIRECTIONS FOR INFOSEC

- **Cryptography Management for SBU Information**
- **Exfiltration Threats to Information**
- **LAN Security for Multilevel Information**
- **Security for Remote Execution**
- **Multilevel Security on Large Networks**
- **Experiments with MISSI Products**

RESEARCH IS VITAL

RADM Wilson

"We must also continue to pursue research and development of technical and procedural solutions to protect our information systems, ..."
-- Hon. Emmett Paige, Jr., June 1996

TIE EDUCATION TO STRONG RESEARCH PROGRAM

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- **Education Benefits from Good Research**
- **Professors Current on Latest Developments**
- **Student Theses Contribute to Research Efforts**
  - > **Links to DoD research programs**
  - > **Co-advisors from industry when appropriate**
- **Some Graduates Continue Research at Next Assignment**
  - > **NSA**
  - > **Fleet Information Warfare Center (FIWC)**
- **New Study Topics and Courses Emerge from Active Research Environment**

DISTINGUISHED LECTURE SERIES

RADM Wilson

- **Notable Computer Security Experts**
- **Lectures to General Audience**
  - > **students**
  - > **faculty**
- **Varied Topics, esp. Computer Security for Commercial World**
- **Simultaneous Class for Smaller Group**
  - > **read papers associated with lecture**
  - > **spend extra time with distinguished lecturer**
- **Video Tape Lectures**
  - > **make tapes available to other institutions**
  - > **incorporate video clips in multimedia materials**
    - **work with new CS multimedia program**

MATRIX FOR NPS COMPUTER SECURITY TRACK

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1st Quarter (Fall/Spring)	CS-2970 (3-2) Object-Oriented Programming 1	CS-3010 (4-0) Computing Devices and Systems	MA-3025 (5-1) Logic and Discrete Mathematics	MA-3030 (5-1) Intro. to Combinatorics & Its Applications	
2nd Quarter (Winter/Summer)	CS-2972 (3-2) Object-Oriented Programming 2	CS-3300 (3-2) Data Structures	CS-3200 (3-2) Introduction to Computer Architecture	CS-3601 (4-0) Theory of Formal Language & Automata	
3rd Quarter (Spring/Fall)	CS-3701 (3-2) Object-Oriented Programming in C++	CS-3650 (4-0) Theory of Algorithms	**CS-3600 (3-2) Introduction to Computer Security**	CS-3460 (3-1) Software Methodology	CS-4900 (2-0) Research Seminar in Computer Science
4th Quarter (Summer/Winter)	CS 3310 (4-0) Artificial Intelligence	CS 3320 (3-1) Database Systems	**CS-3450 (3-2) Operating Systems**	**CS-3111 (4-0) Principles of Programming Languages**	CS 4905
5th Quarter (Fall/Spring)	CS3502 (4-0) Computer and Communications Networks	**CS-3651(4-0) Computability Theory and Complexity**	**CS-4600 (3-2) Secure Systems**	**CS-3670 (3-2) Management of Secure Systems**	
6th Quarter (Winter/Summer)	CS 4203 (3-2) Interactive Computation Systems	Thesis	**CS-4605 (3-1) Policies, Models and Formal Methods**	**CS-4112 (3-2) Distributed Operating Systems**	
7th Quarter (Spring/Fall)	NS-3252 (4-0) Joint & Maritime Strategic Planning	Thesis	**CS 4602 (4-0) Advanced Computer Security**	**Track Requirement**	Note: International students replace NS-3252 with IT-1500.
8th Quarter (Summer/Winter)	Thesis	Thesis	**CS-4614 (3-1) Advanced Topics in Computer Security**	**CS 3690 Applying Information Security Systems**	

Bold Outline indicates courses specifically required for the Computer Security Track

ADVANCED TOPICS IN COMPUTER SECURITY

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- **Examination of Special Topics and New Developments**
- **Filter-based Techniques in Systems with Classified Information**
  - **sanitization**
  - **audit**
  - **IW, etc.**
- **Intrusion Detection**
- **Special Topics**
  - **Trusted systems procurement in DoD**
- **Special Lectures**

DATABASE SECURITY

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- **Capitalize on Major Computer Security Success Story**
- **Data Modeling - MLS Views**
- **Statistical Inference Control**
- **MLS Database Security**
- **Front-End Systems**
- **Industrial Strength (COTS) DBMS for Laboratory Use**

NETWORK SECURITY

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- **Overview of Cryptography**
- **Examination of Cryptographic Protocols**
- **Study of Models for Cryptographic Protocols**
- **Examination of Key Management Problems**
- **Current Issues in Network Security**
  - **Multiple security policies across the network**
  - **Binding of cryptography to access control**
  - **Integrity issues in commercial and DoD systems**
- **Case Studies in Network Security**

SECURITY POLICIES, MODELS, AND FORMAL METHODS

RADM Wilson

- **Discretionary Access Control Models**
  - > **Access Control Matrix**
  - > **Harrison, Russo, and Ullman**
- **Models for National Security Policy**
  - > **Protectionof classified information**
  - > **Protection against unauthorized modification**
  - > **Flow Models, Biba**
  - > **Privilege, Trusted Subjects, etc.**
  - > **Formal Policy Models - study only a few**
  - > **Bell and LaPadula, trace-oriented models**
  - > **Clark Wilson, Chinese Wall**
  - > **criticisms of models**
- **Tools for Formal Analysis in Laboratory Work**
  - > **Discretionary and Mandatory policy examples**
  - > **Specification**
  - > **Covert channel analysis**

BUILDING A SECURE SYSTEM

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- **Concepts of Process and Virtualization**
- **Experiment With Hardware Architectures**
- **Software and Hardware Support for Domains**
- **Examine Placement of Cryptography**
- **Extensive Laboratory Work**
  - **> Simulator for hardware architecture**
  - **> Modern version of "Core Wars"**

MANAGEMENT OF SECURE SYSTEMS

RADM Wilson

- **Problem: Graduates Need to Function in the Real World of Computer Security Today**
- **Solution: Secure Systems Planning and Management**
- **Current Computer Security Technology**
  - > **Personnel security**
  - > **Physical security**
  - > **Configuration management and backups**
  - > **Disaster recovery**
  - > **Risk analysis**
  - > **Account and password management**
  - > **System Maintenance - use of maintenance tools such as COPS, ICEPICK, etc.**
  - > **Emanations protection**
  - > **Hacker profiles**
  - > **Privacy issues - legal, social, ethical**
  - > **User monitoring**

INTRODUCTION TO COMPUTER SECURITY

RADM Wilson

- **Basic Course**
- **Define Security Problem**
- **Protection in computer systems**
  - > **protection of information**
  - > **protection of mechanism**
  - > **Reference Monitor Concept**
    - **notion of completeness**
- **Cryptography and Cryptographic Protocols**
- **Network Security Concepts**
  - > **combine cryptography and computer security**
- **Current Network Security Technology**
- **Secure System Planning & Management Topics**

NAVAL POSTGRADUATE SCHOOL PROTOTYPE COMPUTER SECURITY TRACK

RADM Wilson

- **Introduction to Computer Security**
- **Management of Secure Systems**
- **Building a Secure System**
- **Policies, Models and Formal Methods**
- **Network Security**
- **Database Security**
- **Advanced Topics in Computer Security**
- **Thesis Research**

COMPONENTS OF GENERAL INFOSEC CURRICULUM

RADM Wilson

- **Foundation - building security into a system**
  - > **Well understood principles of computer security**
  - > **Learn methodology to map policy to implementations**
- **System Security Planning and Management**
  - > **Practical knowledge of INFOSEC techniques**
  - > **Students are equipped to understand and address current problems**
- **Extensive Use of Laboratory Exercises**
  - > **Hands-on demonstrations and projects**
  - > **Students gain valuable experience**
- **Security in Complex Systems**

DOD BENEFITS OF NPS COMPUTER SECURITY PROGRAM

RADM Wilson

- **Stress on Significant DoD Problem: Protection of Classified Information**
- **High Payoff**
  - > **NPS computer security program insures a steady flow of well prepared military staff**
    - **officers with MS or Ph.D. in Computer Science**
    - **familiarity with INFOSEC research through thesis work**
  - > **Officers provide**
    - **real-world, operational experience**
    - **understanding of DoD needs and policies**
    - **understanding of interrelationships between services**

RELEVANCE OF INFOSEC FOR NAVAL POSTGRADUATE SCHOOL COMPUTER SCIENCE

RADM Wilson

- **Military Relevance in Computer Security**
  - > **Protection of Information Infrastructure tied to national security**
  - > **Information Security Requirements for the Warrior (C4IFTW)**
  - > **Computers in combat systems**
  - > **Computers in embedded systems**
  - > **Address threat of subversion of computer systems**
- **Support of Emerging Military Service Needs in Computer Security**
  - > **Successful rapid implementation of basic program specializing in computer security**
- **Test Bed for Trusted System Technologies**
  - > **INFOSEC concepts and techniques**
- **Ties to Emerging Commercial Security Efforts**

ESTABLISHING INFOSEC CENTERS

RADM Wilson

- **Two Institutions Receive NSA Startup Support**
- **DoD University**
  - > **Naval Postgraduate School**
    - **prototype program**
    - **DoD center for INFOSEC education**
  - > **Other DoD Universities Follow**
    - **service academies**
    - **Air Force Institute of Technology**
    - **others**
- **Civilian University**
  - > **University of Maryland**
    - **satisfy higher education needs of NSA**
  - > **Other civilian universities follow**

IS COMPUTER SECURITY IMPORTANT?

RADM Wilson

"Our growing dependence on increasingly sophisticated and globally available information technologies creates vulnerabilities that can be exploited by any individual, group or nation in cyberspace. ...

Unprecedented is the Herculean task of protecting all of the nation's electronic communications systems from unauthorized access, manipulation, corruption, and denial of service."

- Hon. Emmett Paige, Jr., June 1996

TOPICS TO BE ADDRESSED

RADM Wilson

1. **Why Computer Security?**
2. **NPS as a Center for INFOSEC Studies and Research.**
3. **What INFOSEC topics should be taught?**
4. **Computer security research at NPS.**

COMPUTER SECURITY EDUCATION
at the
NAVAL POSTGRADUATE SCHOOL

Graduate Education in Computer Security

Presentation to Rear Admiral Richard A. Wilson
for
Computer Science Department Curriculum Review

by

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Center for INFOSEC Studies and Research
Naval Postgraduate School
Monterey, California, USA

August 21 and 22, 1996